

## PATENT ABSTRACTS OF JAPAN

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(71)Applicant : INTERNATL BUSINESS MACH CORP &lt;IBM&gt;

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(72)Inventor : CHRISTENSEN THOMAS C

COKER JONATHAN D

CUNNINGHAM EARL ALBERT

RICHARD CASHMERE JAOOSUKII

KERWIN GREGORY J

DEAN CURTIS PALMER

JEFFREY RALPH ROOPK

## (54) DATA STORAGE DEVICE

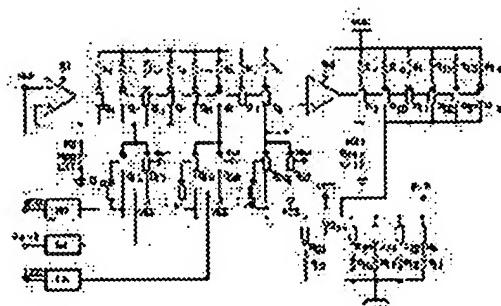
## (57)Abstract:

PURPOSE: To obtain a channel circuit changing the factor of  $\Delta V$  (a minimum voltage change per unit time for discriminating a data and noises)

by adapting a write current and the factor at every conversion head.

CONSTITUTION: In an adjustable write power supply, either of the eight different values of a write current can be selected so as to acquire the optimum value of the write current at a specific radial place regarding the combination of specific head/disk. The selected current is kept within 5% of a specific value. The current value imparts an accurate write current value by utilizing precision reference voltage generated on an electronic card.

Reference voltage is applied to negative inputs to the two operational amplifiers 51, 52 of the circuit of an adjustable current source. The operational amplifier 52 constitutes the current source together with a transistor Q9 and a resistor R21. The operational amplifier 51 and a transistor Q1 form another current source determined by a resistor 20, the same current as a current known as a step current is also made to flow through a transistor Q2 or Q8, and an environmentally stable current weighted at three binary values is generated.



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**CLAIMS**

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**[Claim(s)]**

[Claim 1] It is the magnetic data storage which stores data in the predetermined parallel truck in the rotating data carrier with which it has two or more data front faces, and the magnetic conversion head is used for each above-mentioned data front face. The above-mentioned equipment the predetermined value of two or more above-mentioned write-in current values in a means to generate two or more write-in current values, and the specific radial location of each above-mentioned magnetic conversion head A means to choose in order to make it adapted for every above-mentioned magnetic conversion head, By having the channel circuit which gives a write-in current to the coil of the magnetic conversion head which has a means to choose other values of two or more above-mentioned write-in current values in other radial locations of each above-mentioned magnetic conversion head Magnetic data storage independently characterized by changing the above-mentioned write-in current according to the above-mentioned radius location direction for every above-mentioned magnetic conversion head.

[Claim 2] Each of two or more above-mentioned write-in currents is magnetic data storage according to claim 1 characterized by including the sum with eclipse \*\*\*\*\* with weight by the basic current value and binary value.

[Claim 3] It is the magnetic data storage according to claim 1 which two or more above-mentioned parallel trucks are arranged in the band where plurality adjoins on the above-mentioned data front face, and is characterized by using the different above-mentioned write-in current for every band for each above-mentioned band.

[Claim 4] It is determined in order to optimize in a certain band on each data front face, and it sets to other bands on the above-mentioned data front face, and the above-mentioned write-in current value is magnetic data storage according to claim 1 characterized by being chosen based on the above-mentioned optimum value chosen in the existing band the account of a top.

[Claim 5] The above-mentioned write-in current value is magnetic data storage according to claim 1 characterized by being determined in order that the radius on each data front face may optimize in the inside band which is min, and being chosen from the inside band on the above-mentioned data front face by the predetermined procedure based on the above-mentioned optimum value chosen in the above-mentioned inside band in other bands where a radius is large.

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[Translation done.]

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[Industrial Application] If this invention relates to the memory to rotate and it says still more concretely, it will relate to the circuit which processes serial data in a magnetic-disk actuation system.

[0002]

[Description of the Prior Art] Data storage is continuously pressed for the improvement in respect of two. One of them is the continued efforts for making recording density increase, and another is continued development for decreasing the response time with a high-speed configuration component or the improved high-speed technique more.

[0003] Recording density makes bit density increase and it is increased by making narrower the width of face and spacing of a data track. Those change decreases the dimension of a bit domain. Consequently, in order to maintain the same criterion as the criterion of the dependability attained to this, it is necessary to raise reading and write-in capacity to the engine performance of higher level.

[0004] There is \*\*V which is used in order to discriminate the data signal and noise signal on a channel from the write-in current supplied into a write-in mode of operation at a transducer in reading mode and which is the threshold of the electrical-potential-difference change per unit time amount in the property taken into consideration in order to optimize the engine performance of a driving gear. In order to obtain optimum performance conventionally, setting up the value of those both is usually performed. However, when the parameter of those both is used, the values which obtain the best engine performance differ for every converter, and change also with radial locations of the converter which is the function of the head rate to a medium front face.

[0005] Furthermore, another problem to produce is the phenomenon of not functioning appropriately, or the configuration component considered to be the outside of a specification criterion being combined with other configuration components, and functioning appropriately, when the configuration component it was presupposed by the test that it was within the limits of product specification is combined with other configuration components.

[0006]

[Problem(s) to be Solved by the Invention] In order to improve the overall engine performance of a driving gear, and to fit the factor of a write-in current and \*\*V (the minimum electrical-potential-difference change per unit time amount for distinguishing data and a noise) for every conversion head and to fit a system to the particulars of various configuration components, it is offering the channel circuit of the disk driving gear to which it was made to change those factors.

[0007]

[Means for Solving the Problem] This invention offers the channel circuit of the disk driving gear to which it was made to change a write-in current and \*\*V (the minimum electrical-potential-difference change per unit time amount for distinguishing data and a noise) for every conversion head. This improves the overall engine performance of a driving gear, and it is performed in order to fit those factors for every conversion head. These fit a system to the particulars of various configuration components again.

[0008] As for the threshold of a write-in current and \*\*V, both are given with eight amplitude, and the truck is arranged on each data front face at three adjoining bands as shown in the example. In write-in actuation, in order to optimize the write-in current in a given truck location, an operating sequence is used. The write-in current is adapted for the radial location of a truck, the property of a head, and a record channel configuration component.

[0009] With optimization of the write-in current for a head, the number of the errors produced during operation of the optimization technique gives a close correlation with the overall engine performance of equipment. Since the parameter in which many measurement is impossible affects such engine performance, it is impossible to measure the overall engine performance directly.

[0010] And the above-mentioned current is more low in an inside diameter, and in order for a data track to meet radially and to adjust so that it may be adapted for the changing higher rate and the higher flight height of a conversion head in an outside diameter, it changes about each band of a truck. Such a write-in big current is needed that flight height is high.

[0011] When data are read in a truck, the amplitude of the signal recognized as data or the threshold of \*\*V changes in order to improve the overall engine performance. In the data band of the outside which has a large tangential velocity, the value of large \*\*V is needed rather than the case where it is the inside data band where resolution benefits a low rate low.

[0012] In the environment of the usual disk driving gear, two or more disks which have a data front face on both sides are used, and at least one head is used for each data front face. Usually, 16 heads are used in eight disk driving gears which have the driving gear of four disks which have two heads on each front face, or a head single on each front face. Under such conditions, an adjustable write-in current and \*\*V are adapted also for each of the combination of 16 which consists of a specific head, a channel circuit, and the data front face of disk media respectively.

[0013] Another factor in the overall engine performance of a disk file is data recovery procedure which makes the increment in the number of software errors accompanying reduction of the amplitude of a bit domain and a reading signal permit, and needs to maintain generating of a hard error at the same level.

[0014] By making \*\*V adjustable, another data recovery procedure is added to the above-mentioned recovery sequence. It is transparent for a system and the procedure usually performed after correction of the error in the data flow which does not produce delay at all is a

procedure of reading data again, and making the increment of the head carrying out in each direction partly, shifting it to it, and reading it again. Then, rereading can be performed before more complicated various error correcting codes using the value of the versatility of  $**V$  by which the increment was carried out. This makes possible one means by which I accept it in order to increase the capacity of a storage system.

[0015]

[Example] Drawing 1 shows the typical magnetic-disk driving gear with which the actuator assembly 10 has accessed the disk 11 of the two bottoms in four spindle actuation assemblies for disks.

[0016] On the pub 12, it is isolated by the spacer 13 and equipped with four disks. The pile of the disk is held by compressive force on a hub 12 with the elastic component 15, a color 16, and a contracting ring 17, and this contracting ring 17 is being fixed to the outside front face of a hub 2 by the shrinkage fit after heating expansion was carried out and being assembled. It is equipped with its hub / disk assembly on the spindle shaft 18 so that Rota of a disk 11, a hub 12, the spindle shaft 18, and the spindle drive motor 19 may be directed by the bearing 20 and it may rotate [ it is in agreement and ].

[0017] The linear actuator carriage 21 is driven with the voice coil wound on the bobbin 23, and operates to the method of inside, and the method of outside radially. This voice coil reciprocates in the air gap 24 of operation to which a field is radially set with eclipse

\*\*\*\*\* 25 with a polarity, and a pole piece 26. The actuator carriage 21 is guided in accordance with a radial path with three pairs of rollers 28 (one of them is illustrated) which are engaging with the rod 29, i.e., a rail, on each side face of this actuator carriage. Two pairs of rollers are mutually isolated and arranged in the die-length direction in one side face, and one pair of rollers are arranged in the medium of two pairs of rollers besides the above in the die-length direction in the side face of another side. In order to remove the play of the machinery between carriage / roller assembly, and a rail 29, or sag, bias of one roller of each set is carried out with the spring.

[0018] The above-mentioned carriage assembly contains the body 31 which \*\*\*\* a roller 28, a voice coil, and the converter / suspension member assembly with which the elastic suspension member 34 which \*\*\*\* the conversion head 35 is attached in the arm 33. the coil of the above-mentioned transducer -- each and flexibility -- it is attached in the arm electronic module 36 on a conductor 37 in the solder terminal 38. The arm electronic module 36 is connected to other parts of a disk actuation circuit by the conductor on the flat cable part 39. Moreover, inside a head / disk assembly, the circulation of air induction is carried out [ circulation ] by impeller actuation of a hub 12 and the revolution disk 11 arises. Air flows from the inside of a hub to the method of outside radially through the puncturing 41 in a spacer 13.

[0019] Drawing 2 is a rough block diagram showing reading / write-in signal which is transmitted to the disk actuation circuit module and conversion head relevant to a data channel, and is received.

[0020] The arm electronic (AE) module 36 is usually \*\*\*\*(ed) on the actuator 37 as shown in drawing 1. AE module gives insurance and diagnostic circuit actuation to four fundamental functions, i.e., reading mode actuation, write-in mode actuation, control-line selection actuation, and a list. In reading mode, the AE module 36 gives initial high gain magnification of a head signal level. In write-in mode, this AE module makes possible alternating current magnetization on the front face of a disk which constitutes the data bit which was made to reverse the write-in current in one of the four heads which it operates, therefore was encoded.

[0021] An actuation stage passes a write-in current by turns on both sides of a centre tap mold ferrite conversion head. Selection discharge is also possible for AE module besides reading / write-in mode. This mode is used mainly for data integrity or safety. The condition will be removed, if selection discharge of this module is carried out when a module becomes write-in mode accidentally. AE module is used also in order to secure the dependability acquired by carrying out monitor Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. of the condition that the recorded data may be destroyed again, and reporting it. The monitor also of the integrity of the control line with which the monitor of the selection in a module and the condition of a write-in circuit was carried out, and also the safeguard was attached in a recording head and it again is carried out.

[0022] The AGC module 44 gives reading, a store, and a safeguard like the case of the AE module 36. When a channel is in reading mode, the AGC module 44 receives the head signal amplified from the AE module 36. This signal is amplified from it, and is held at the fixed amplitude, and is sent to the detection module 46 through a filter 45. Two fundamental write-in actuation is performed by the AGC module 44, a write-in trigger, and the write-in current source.

[0023] The write data from an encoder circuit is changed and it is sent to the front-end actuation stage for a store in the AE module 36 through a flexible cable. Another write-in function is a current source programmable by the triplet (write-in current subdevice bits 1, 2, and 3) to generate eight separate values. This capacity gives a means to compensate the allowable error to other record components. Since the AGC module 44 includes a write-in mode circuit, when those circuits do not operate well, in order to ensure data integrity by carrying out the monitor of the differential reading signal line, and checking a failed state, the safety circuit is incorporated by carrying out the monitor of the write-in circuit in an AGC module, and securing suitable actuation of a write-in current selection line.

[0024] The detection module 46 includes only a reading mode function only for the purpose of changing into a series of digital pulses corresponding to the amplified linear head signal. All wave-like peaks are detected, and in order to find out the peak of the obtained effective data, a series of peak filter circuits are used.

[0025] Two important criteria are applied to all the peaks distinguished by difference  $**V$ , i.e., "the threshold of V." The circuit which performs those two functions performs distinction between data required in order to make a clear data pulse train let it pass to the VFO module 47 with a certain combination logic, and the peak which is not essential. In the detection module, the capacity which makes it possible to choose externally the value used for a detection algorithm is established. The amplitude of  $**V$  of 8 level is programmable using the control line,  $**V$  bit 1 [ i.e., ], and 2 and 3.

[0026] Only the reading mode function has the VFO module 47 as well as the detection module 46. The function is supplying the reading clock which assigns the bit position to an input data pulse, and synchronizes with the spindle of a disk file. This VFO module is comparing the pulse train with the output of the oscillator continuously. In reading mode, the pulse train to compare is reading data.

[0027] Adjustment proportional to the phase error by which each compared pulse was measured is performed in the frequency of an oscillator. The magnitude of the sampled error or the adjustment per response time is determined by in which of the two modes it is. Before receiving actual data, the VFO module 47 receives a series of constant frequency pulses which constitute the synchronous field. This field is written in data and coincidence, and it is used in order to prepare or set up a VFO module so that actual data may be received.

[0028] If the synchronous field is generated to the input of a VFO module, this module will be put on the quick synchronous mode. It operates promptly so that time amount required since this module makes max adjustment of the oscillator per [ which was sampled ] phase error between the time amount which has this module in that mode, therefore this module is locked to data may be made into the minimum.

A VFO module is in reading mode between the remaining time amount. Between the parts of the last of the synchronous field and the whole data field are covered, and the response of a VFO module is made late so that compensation of the optimal frequency may be acquired.

[0029] The write-in power source which is shown in drawing 3 and which can be adjusted makes it possible to choose either of eight different values of a write-in current so that the optimal value of a write-in current may be acquired in a specific radial location about the combination of specific head/disk. Furthermore, the selected current is less than 5% of an assignment value. This allowed value is attained without needing to use active laser trimming which cost requires.

[0030] Furthermore, this current source gives an exact write-in current value by using the precise reference voltage generated on the electronic card. Reference voltage is applied to the negative input of two operational amplifiers 51 and 52 of the circuit of a current source which can be adjusted as shown in drawing 3.

[0031] An operational amplifier 52 constitutes a current source with a transistor Q9 and resistance R21. The reference voltage currently maintained at the ends of R21 by the loop formation of the operational amplifier 52-transistor Q9 sets a current to a transistor Q9. This current is stable in environment and is only the function of 2.5% precision voltage reference and 1% resistance allowed value. And the same current as the current in a transistor Q9 flows also to a transistor Q10 thru/or Q14. This current known as a basic current value is 5 times the current in a transistor Q9.

[0032] An operational amplifier 51 and a transistor Q1 form another current source determined by resistance R20. The same current as this current known as a step current flows also to a transistor Q2 thru/or Q8, and the current stable in environment by which weighting was carried out by three binary value arises. These three currents are switched by three differential switches which operate with three receivers M3, M4, and M5 and which were formed using a transistor Q15 thru/or Q23. With a possible combination of eclipse \*\*\*\*\* with weight, eight current level is obtained by three binary value.

[0033] The output of three differential switches is driven in the output mirror which consists of a transistor Q24 thru/or QN with a basic current value. The output mirror multiplies the sum total of eclipse \*\*\*\*\* with weight, and a basic level current by the large number by binary value, and acquires a desired write-in current value.

[0034] Drawing 4 shows the detailed block diagram of a circuit used for the parameter of \*\*V which can be adjusted. The \*\*V detector 55 senses the electrical potential difference VDEL of the ends of Resistance RDEL. In order to set up \*\*V electrical potential difference, 2.5% reference voltage of 2V is used.

[0035] \*\*V electrical potential difference is divided into two components of a basic value and a delta value. The basic electrical potential difference of \*\*V expresses the minimum request value of \*\*V. The delta value of \*\*V expresses the addition added to the basic electrical potential difference of \*\*V, and it changes dynamically through the digital control bus of a triplet.

[0036] In order that drawing 4 may pressure the reference voltage of 2V partially, the basic electrical potential difference generated by using resistance R11 and R12 is shown. the electrical potential difference -- the module pin 56 -- setting -- a monitor -- or it is corrected.

[0037] An amplifier 57 carries out the buffer of the basic electrical potential difference, and supplies it to the mutual-conductance amplifier constituted by an amplifier 58, transistors Q5 and Q6, and the list by resistance R14 and R15. The current acquired as a result produces a voltage drop at the ends of the resistance RDEL in \*\*V detector, and produces the basic electrical potential difference of \*\*V.

[0038] The emitter region of transistors Q5 and Q6 is the same, and the same collector current flows to transistors Q5 and Q6 identically [the emitter resistance of equipment ] therefore. Since the ratio of resistance R14 and Resistance RDEL is 4 to 1, the electrical potential difference generated to the ends of Resistance RDEL is the quadrant of the electrical potential difference applied to the input of amplifier 58. This offset current is controlled by carrying out laser trimming of the module substrate resistance RSUB1, carrying out the monitor of the electrical potential difference of the ends of Resistance RDEL.

[0039] In order to pressure the reference voltage of 2V partially, resistance R1 and R2 is used for an increment electrical potential difference, and it is generated. An amplifier 59 carries out the buffer of the increment electrical potential difference, and supplies it to the mutual-conductance amplifier constituted [ an amplifier 60, a transistor Q0, Q4C, Q2C and Q1C, and a list ] by RS/2 at resistance R4 and R5, R5/4, and a list. The relative emitter regions of a transistor Q0, Q4C, Q2C, and Q1C are 1, 4, 2, and 1 respectively, the inverse number of emitter resistance is the same ratio, and the collector current of those equipments is the same ratio as an emitter region.

[0040] The differential converter pair on [ each ] transistor Q4C, Q2C, and Q1C of the current source of a mutual-conductance amplifier makes it possible a turn-on or to carry out a turn-off with the logic signal with which those currents had the TTL-ECL converter let it pass. Since those currents have the ratio of 4, 2, and 1 in binary, the magnitude of the current put together has the magnitude of the binary number of the triplet on a digital bus.

[0041] The same current as the current in the collector of transistor Q4A, Q2A, and Q1A put together flows to resistance R6 and R7 at transistor Q3A, Q3B, Q3C, and Q3D list, and flows also to resistance R8 and R9 at a transistor Q7A, Q7B, and Q7C list, and produces a voltage drop at the ends of Resistance RDEL. Since the ratio of resistance R4 and Resistance RDEL is 20 to 1, the electrical potential difference generated to the ends of RDEL to the digital control input binary [ 1 ] is 1/20 of the electrical potential difference applied by the resistance dividing network of resistance R1 and R2. All can be obtained to seven increments in the increment electrical potential difference of \*\*V in the binary input of 1. An offset error of this circuit is made zero by the offset current added to the input of amplifier 60. This offset current is controlled by carrying out laser trimming of the module substrate resistance RSUB2, carrying out the monitor of the electrical potential difference of the ends of RDEL.

[0042] By the ability acquiring the adjustable write-in current value which can be set and reset for every head and every truck, and the value of adjustable \*\*V, while manufacturing in order to improve the engine performance, the impossible technique becomes possible conventionally which performs test and adjustment. This technique can be used as a rating test, in order to make the ratio of the equipment which fills the activity of the required engine performance by making combination of the low configuration component of the engine performance into a permissible level increase and to make a throughput increase so that it can use in order to optimize the combination of all head/media, or it may mention later.

[0043] The rating test detects more a single configuration component or the error engine performance of a single disk file to accuracy. By enabling the activity of the engine performance of a stricter configuration component, more exact test data improves the yield, improves cost by decreasing abolition of the good configuration component measured as a defect, and improves quality by detecting more poor configuration components measured as good. The test detects the error engine performance which is not desirable irrespective of whether it is generated from interference (squeeze) or other factors of the signal-to-noise ratio which is not desirable, and an adjoining truck.

[0044] Next, the sequence of a specific test and optimization is shown. Since it is adapted for fluctuation with the distance of a head from the bottom of heart during the revolution reflected in the tangential velocity and the adjustable flight height from which a head changes, the data track is divided into three bands of an adjoining truck, i.e., the inside band whose radius is min, the interband region, and the outside band. The inside band is the most important, therefore a test and an optimization technique are performed about both a write-in current and  $**V$  in the truck of an inside band. If the optimum value of a write-in current or  $**V$  is set up in the test truck of an inside band, setting out corresponding to the truck of an interband region and an outside band will accomplish.

[0045] the value which boils the following table and is shown is 0 of a triplet signal thru/or setting out of 7 which chooses an each write-in current or  $**V$ .

[0046]

[A table 1]

Table I A medium and an outside band sake Selection of a write-in current An inside band Corresponding setting out An optimum value Interband region Outside band 6 7 7 5 6 7 4 5 6 3 4 5 2 3 4 1 2 3 0 1 2 [0047]

[A table 2]

Table II A medium and an outside band sake Selection of  $**V$  An inside band Corresponding setting out An optimum value Interband region Outside band 5 6 7 4 5 7 3 4 6 2 3 5 1 2 4 0 1 3 [0048] Test information is written in each of five trucks in an inside band currently respectively isolated by at least two medium trucks. Old information, new information, and squeeze information are three information patterns which are written in the overall length of the data field on a truck, and are repeated as following respectively.

[0049]

[A table 3]

A pattern Location 1. old information The head shift 2. old information of +2 microns of on-trucks The head shift 3. new information of -2 microns of on-trucks On-truck 4. squeeze information HETSU of -1 micron of on-truck -1 trucks DO shift 5. squeeze information HETSU of +1 micron of on-truck +1 trucks DO shift [0050] About each of five trucks in which test information was written, a write-in current test sequence repeats a step sequence, and is performed.

[0051] 1. Write in an information pattern like \*\*\*\*. A current write-in current is used.

[0052] 2. Read an new information pattern 10 times and record the number of failures of each sector. Current  $**V$  is used.

[0053] 3. Remove the error relevant to the four worst sectors. The remaining error is counted.

[0054] 4. Repeat steps 1, 2, and 3 twice, and repeat them 3 times in all.

[0055] 5. Total all counted errors.

[0056] Next,  $**V$  test sequence to describe is repeatedly performed about each of the truck in which test information was written.

[0057] 1. Read an new information pattern 30 times and record the number of failures of each sector. Current  $**V$  is used.

[0058] 2. Remove the error relevant to the four worst sectors on each truck. The remaining error is counted.

[0059] Also in any of the above-mentioned test sequence, if the sum total of an error count is zero, the increment of the error count will be carried out to 1. It is made for the division by zero error not to produce this in a control algorithm.

[0060] Drawing 5 shows the control technique and sequence for optimizing the value of a write-in current and  $**V$ . When a head fails in an early cut, the sequence is always written in and optimizes a current.  $**V$  is optimized only when not improving a head beyond a specification [ need / a write-in current / to be optimized ].

[0061] It initiates a test using initial setting of a write-in current and  $**V$ . When the high value as which the sum total of the error between the 1st write-in current test sequences was specified is exceeded, the head is promptly used as a defective, and when the sum total of the above-mentioned error is below the 2nd predetermined sum total, it is not tested further, the head being promptly used as an accepted product.

[0062] When producing neither of those conditions, the increment of the write-in current is carried out, and the test of a head is repeated until the number of errors stops showing reduction rather than a front test sequence. And the decrement of the write-in current is carried out, and a test sequence is repeated until an error count will not decrease. And the current for a head is set as a final value, and when there are few last error counts than the 2nd predetermined sum total, a test sequence is stopped, a head being used as an accepted product.

[0063] The decrement of the  $**V$  is carried out,  $**V$  test sequence is performed, and a step is repeated by it until the counted number of errors becomes less than a before sequence in it, when the head does not fulfill the specification to the end of a write-in current optimization test sequence. And the increment of the  $**V$  is carried out, a test sequence is performed, and a step is repeated until the sum totals of an error will not decrease in number rather than the test sequence in front of a degree. When the number of errors in the value by which  $**V$  was optimized is compared with the 3rd predetermined number which shows the combination of the head/medium which fulfills a specification and an error count exceeds such a number, a head is used as a defective, and when there are few error counts than such a number, let a head be the accepted product which fulfills a required specification.

[0064] It is used also as an effective means in correction of data and a restorative procedure again that the parameter in important reading mode can be changed. An error situation can be identified without the procedure relaying data flow including the procedure in which processing of the serial data read in the storage identifies and corrects an early error, and it can correct appropriately, therefore is transparent for a system.

[0065] It is required for a more complicated error situation to call data recovery procedure. This is a procedure which is performed until an error is corrected, and the procedure is suspended, or all the routines of a procedure are continued and the error in which difficult recovery is impossible is identified and which consists of many steps. Today's equipment has high dependability, and it depends for an accidental error on the ability to recover and correct so that it may not become the unrecoverable failure with the satisfactory engine performance of equipment "difficult" in order that an error may read data. [ although there is no need of using data recovery procedure rash ] Moreover, equipment is important also for data being recoverable with the capacity of itself, without works intervening eventually, in order to recover a very important user's data.

[0066] The activity of adjustable  $**V$  gives another data recovery means. It is used, in order that using the detection parameter of adjustable  $**V$  combining rereading actuation as a part of data recovery procedure may supplement with the step of other data recovery procedure and it may make it the most effective. The various steps of data recovery procedure aim at any recovery of a time shift or the error of the amplitude.  $**V$  step is one technique in which I accept it for recovery from the error of the amplitude.

[0067] When rereading and  $**V$  which decreased using increased  $**V$  are used for the flow chart of drawing 6, it shows the step of the

data recovery procedure by the step of reading.

[0068] Detection of the error by the inequality of what was written in using the error correcting code (ECC) value and data which were calculated newly initiates data recovery procedure. The step of recovery procedure usually becomes gradual more complicated, requires often more long time amount, and it is arranged so that it may have usually more large error recovery capacity.

[0069] An early procedure is only carrying out rereading of the data many times, and this can conquer the random error condition like the noise which may not exist in the continuing cycle. The following procedure is shifting a head to radial [ one ] first, making it shift to radial [ of another side ] next, and usually performing the step of rereading after rereading which used the double burst ECC.

[0070] When the inequality of an ECC value continues, rereading is performed using the value of programmable  $^{**}V$  which fell so that recovery from a possible lack bit error might be performed. Next, rereading is performed using the value of  $^{**}V$  increased so that recovery from a possible excess bit error might be performed. When recovery is not attained, the above-mentioned procedure is continued until all steps are performed. It is that an error is made to a difficult error and reported, after the whole procedure is performed.

[0071] It is important that the single conversion head near the design limit of a configuration component can be tested to accuracy. good -- it can reach and a poor configuration component can be classified more into accuracy. Setting out of the test specification will be able to be carried out by the design limit soon. This means that a more exact test can be performed, without needing only small allowances with a test specification. The test which was conventionally performed to the correlation with the actual engine performance and which is not more desirable means having needed the allowances of a test further.

[0072] By using a today more strict correlation, allowances can be decreased and the quality of the manufactured whole product is not influenced. With it, the yield of a product can be improved, and cost can be reduced, the competitive strength of equipment can be heightened, or the both can be attained.

[0073] The actual test is the same as the test performed in the precision test under disk file development. The old information of two bands is written in by being able to shift a head location from the location of introduction and normal to each radial one, and writing in a data pattern. Next, a data pattern (usually another random pattern) is written in the on-truck location of normal. And a head is accessed by the next truck, it is shifted to the direction of a data track, and the 3rd random pattern is written in. This is called a squeeze truck. Another squeeze pattern is written also in an opposite hand. And the error rate of a data track is measured from an on-truck location. In order to take more desirable statistics, the reading is repeated on the same truck and a store and reading are repeated in other three trucks showing the truck with which so that the representation average of the error engine performance may be obtained, or it adjoins only for servoes. [ the servo track of four molds for operation of a sector servo ]

[0074] In a typical driving gear, since what is necessary is not to measure the actual error rate of a very good head, and to measure only the head on a boundary, only a short time requires the procedure. Since ECC and automatic recovery improve an apparent error rate remarkably, the unsettled error rate permitted is sometimes remarkably high.

[0075] When the width of face of a head is narrow, the squeeze truck can be considerably distant from the data track, and a little adverse effect produced in the usual disk file actuation cannot be found. Therefore, a head is tested about interference of the same mold as what is seen in the usual disk file actuation. In the case of a head with wide width of face, into the edge of a data track, it projects selectively, and like the usual disk file actuation, eliminate data selectively, interference is written in further, or a squeeze truck carries out. By writing in a squeeze truck with a data track closely, the adjustment which few [ much ] trucks mistook is simulated rather than it is generated in the usual disk file actuation. This enables the test of a failure device by short test time amount. The head with wide width of face is tested under the conditions of the usual signal-to-noise ratio using the squeeze pressed from the adjoining truck. Since the head which has the engine performance of usual or a good signal-to-noise ratio was equal to interference of a bigger squeeze, it turned out that this is an appropriate test for a head.

[0076] An efficient head may be used as an accepted product even if the head with bad quality and effectiveness may be used as a defective even if it is within the limits of the specification of width of face, and width of face is too wide. Therefore, although this test makes the maximum width of recording track an indeterminate a little, it measures the actual engine performance of a disk file.

[0077] Most tests of a magnetic conversion head have only the weak correlation to the engine performance of a disk file. The compromise made ambiguous accomplishes in a specification whether a configuration component is permitted. Although the parameter of many which cannot measure a configuration component may affect an error rate, it does not affect so much the engine performance of a head of passing a magnetic amplitude test.

[0078] The activity of the test of an error rate makes it possible to test a head or the configuration component of a disk using the data transfer channel used for the product. Therefore, although the small factor which affects the engine performance in the test of a magnetic conversion head is not discriminable, those effects are directly included in measurement of an error rate. Therefore, the engine performance of a disk file can be predicted more to accuracy rather than the case where an amplitude measurement system is used.

[0079] The error rate of a actual disk file differs from the error rate of the tested head a little by some factors. The one factor is that the test of a magnetic error rate is performed using a standard disk. In a disk file, the disk used may have engine performance which differs and is different. The noise level in a disk file may differ slightly separately, and another difference produces a difference of a certain extent in the engine performance of the same head.

[0080] In the environment of actual equipment, a disk file may have the specification of the throughput which shows the error rate of an average disk file. It depends for the error rate of an average disk file on fluctuation of the error rate covering each whole front face between the configuration components on each front face of the whole disk file.

[0081] In the configuration component in the abbreviation worst, the fluctuation by the inclination of the engine performance accompanying a radius seldom differs from the prediction performed using the single cylinder test data. This is for an inside radius to occupy most error rates in many disk files. The overall prediction based on the error rate in an inside radius is quite exact.

[0082] In prediction of the engine performance of a disk file, although neither of the head tests is completely exact, the magnetic error rate test is more exact than a former test.

[0083]

[Effect] In order according to this invention to improve the overall engine performance of a driving gear, and to fit the factor of a write-in current and  $^{**}V$  (the minimum electrical-potential-difference change per unit time amount for identifying data and a noise) for every conversion head and to fit a system to the particulars of various configuration components, the disk driving gear to which it was made to change those factors is obtain.

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[Translation done.]

**\* NOTICES \***

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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**DESCRIPTION OF DRAWINGS**

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**[Brief Description of the Drawings]**

- [Drawing 1] \*\* -- drawing of longitudinal section of the typical magnetic disk memory in which main machine components are shown,  
[Drawing 2] The rough block diagram showing reading and a write-in mode of operation in the electronic-module list relevant to the data channel of a \*\* disk driving gear,  
[Drawing 3] Drawing showing the AGC modular circuit used in order to generate a \*\*\*\*\* write-in current,  
[Drawing 4] \*\*\*\* -- drawing showing the detection modular circuit used in order to generate the value of strange \*\*V,  
[Drawing 5] \*\*\*\* -- the flow chart showing the procedure for optimizing the value of a strange write-in current and adjustable \*\*V,  
[Drawing 6] It is the flow chart showing data recovery procedure including rereading using the value to which \*\* \*\*V increased or decreased.

**[Description of Notations]**

10 ... An actuator assembly, 11 ... A disk, 18 ... Spindle shaft, 19 ... A spindle drive motor, 21 ... Linear actuator carriage, 24 ... An air gap of operation, 25 ... A permanent magnet, 26 ... Pole piece, 28 [ ... Elastic suspension member, ] ... A roller, 29 ... A rod, i.e., a rail, 33 ... An arm, 34 35 ... A conversion head, 36 ... Arm electronic (AE) module, 37 ... flexibility -- a conductor and 39 ... a flat cable part and 44 ... an AGC module and 46 ... a detection module and 47 ... a VFO module, and 51 and 52 ... an operational amplifier and 55 ... \*\*V detector.

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[Translation done.]